

## TENT COOPERATION TREATY

PCT

REC'D	27 JUN 2001
WIPO	PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

14

Applicant's or agent's file reference HL71321/001/CIV	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/01216	International filing date (day/month/year) 30/03/2000	Priority date (day/month/year) 31/03/1999
International Patent Classification (IPC) or national classification and IPC G02F1/313		
Applicant UNIVERSITY OF BRISTOL		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I    Basis of the report
- II    Priority
- III    Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV    Lack of unity of invention
- V    Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI    Certain documents cited
- VII    Certain defects in the international application
- VIII    Certain observations on the international application

Date of submission of the demand 25/09/2000	Date of completion of this report 25.06.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Diot, P Telephone No. +31 70 340 3282



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/01216

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):  
**Description, pages:**

1-12                   as originally filed

**Claims, No.:**

1-18                   as received on                   26/03/2001 with letter of                   22/03/2001

**Drawings, sheets:**

1/5-5/5               as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description,           pages:
- the claims,               Nos.:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/01216

the drawings,      sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*  
**see separate sheet**

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)                  Yes: Claims 1-18

No: Claims

Inventive step (IS)           Yes: Claims 1-18

No: Claims

Industrial applicability (IA) Yes: Claims 1-18

No: Claims

2. Citations and explanations  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB00/01216

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

I A. The applicant has deleted the following feature in claim 1 (the same applies for claim 3):

input waveguide and upper waveguide into which input light can be coupled vertically in a manner controlled by an electrical signal.

This feature is presented as essential in the disclosure of the invention, indispensable as such for the function of the invention in the light of the technical problem which it seeks to solve (page 1, lines 12).

The deletion of this feature introduces subject-matter which extends beyond the content of the application as filed, contrary to Article 19(2)/Article 34(2)(b) PCT.

B. The amendments filed with the letter dated 22.03.2001 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendments concerned are the following:

- (1) "a second upper waveguide"
  - (2) in the OFF state varying the refractive index profile of the input and output waveguides or of the first and second upper waveguide ;  
and (3)
- in the ON state varying the loss/ gain characteristics of the input and output waveguides.

It is clear from the description (page 6, lines 10-13) that the light is coupled between the lower passive waveguide and a upper active waveguide (see also page 10, lines 01-18) and that the carriers injection produces a change of refractive index and simultaneously a change in the loss/gain characteristic in the upper waveguide only and in the ON state only (page 6, lines 16-20 and page 4, lines 01-08)

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01216

**II. Reference is made to the following document:**

D1: MACIEJKO R ET AL: "ANALYSIS OF AN INGAASP/INP TWIN-OVERLAYERED-WAVEGUIDE SWITCH" IEEE JOURNAL OF QUANTUM , vol. 30, no. 9, 1 September 1994 (1994-09-01), pages 2106-2113.

Claims 1, 3 and 5 relate to a switching device comprising, intersecting lower waveguides, and an upper waveguides arranged above the lower waveguide with a corner mirror located at the intersection. Such a device is known from D1.

The device is further characterized by: in the ON state the refractive index of the upper waveguide is varied providing switching operation and simultaneously the loss/gain characteristic of the upper waveguide is varied.

In the OFF state (bar state) the upper layer has a high absorption to the light guided in the lower waveguide thereby reducing crosstalk.

Such a simultaneous action in a vertical switch is not derivable from D1.

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CLAIMS

1. A scheme of constructing an integrated optical crosspoint switch which provides minimum occupied substrate area, comprising:

5 forming input and output optical waveguides intersecting each other, and

forming, above the input waveguides leading to the intersection, upper waveguides into which input light can be coupled vertically in a manner controlled by an 10 electrical or optical signal, and

providing corner mirrors at the intersections, which penetrates the upper waveguides and reflects the light in the waveguide to a perpendicular direction, and

15 forming, above the output waveguides leading away from the intersections, upper waveguides leading away from the corner mirror, from which light can be coupled vertically in a manner controlled by an electrical or optical signal, and

20 controlling the optical mode distribution in the coupled waveguides to minimise the coupling length.

2. A design approach to minimise crosstalk level and increase the modulation depth in the crosspoint switches, comprising:

25 varying the refractive index profile in the VCWS to realise switching function, and

reducing the optical loss of, or introducing optical gain in the upper waveguide at "ON" state to enhance the switching, and/or

30 increasing the optical loss of the upper waveguide at "OFF" state to suppress the stray signal level into the output.

3. A switch structure as claimed in claim 1, which uses the design principle claimed in claim 2.

35 4. A switch structure as claimed in claim 1 and 3, in which the angle between the input and output

-15-

waveguides is 90 degrees.

5        5. A switch structure as claimed in claim 1 and 3, in which the angle between the input and output waveguides is not 90 degrees.

6. A switch structure as claimed in claim 1, 3, 4 and 5, in which the refractive index of the upper waveguide is changed during switching.

10      7. A switch structure as claimed in claim 1, 3, 4 and 5, in which the refractive index of the lower waveguide is changed during switching.

8. A switch structure as claimed in claim 1, 3, 4, 5, 6 and 7, in which the upper waveguide is of the same width as the lower waveguide.

15      9. A switch structure as claimed in claim 1, 3, 4, 5, 6 and 7, in which the upper waveguide is not of the same width as the lower waveguide.

10. A switch structure as claimed in claim 1, 3, 4, 5, 6, 7, 8 and 9, in which the upper waveguide is of the same thickness as the lower waveguide.

20      11. A switch structure as claimed in claim 1, 3, 4, 5, 6, 7, 8 and 9, in which the upper waveguide is not of the same thickness as the lower waveguide.

12. An array of switches, interconnected or not, consisting of individual switches which are as claimed 25 in claim 1, 3, 4, 5, 6, 7, 8, 9, 10 and 11.

13. An array of switches, as claimed in claim 12, with tapered input/output waveguide ends to enhance coupling between the array and optical fibre.

30      14. An individual switch or an array of switches as claimed in any of the preceding claims, wherein the substrate material is substantially planar.

35      15. An individual switch or an array of switches as claimed in any of the preceding claims, wherein the upper and the lower waveguides are terminated by end facets that are not perpendicular to the waveguide axis.

-16-

16. An individual switch or an array of switches as claimed in any of the preceding claims, wherein the substrate and/or waveguide material(s) are one of the following: a semiconductor, a silica-based material, a  
5 polymer.



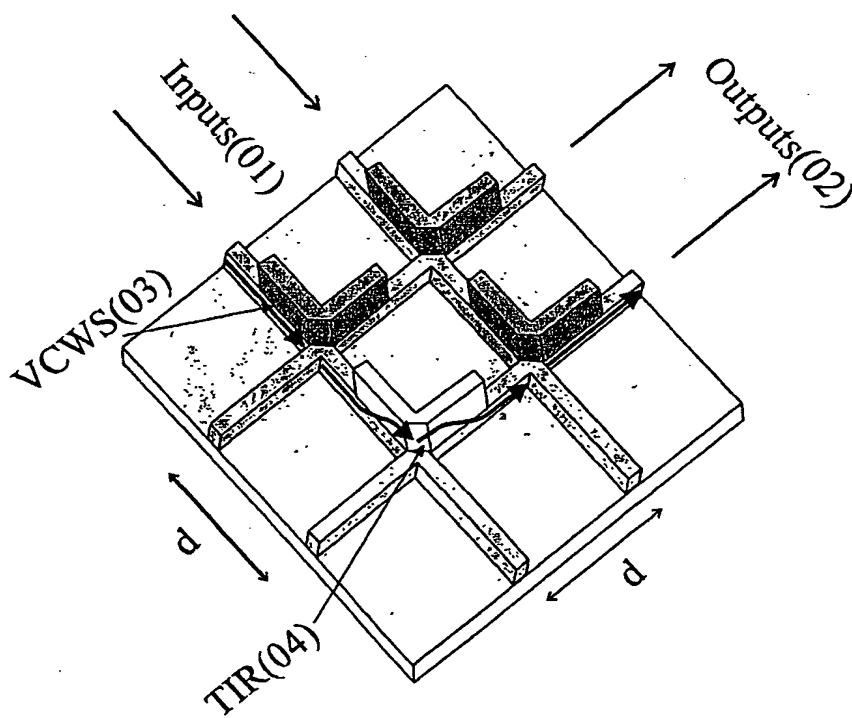
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> :	A1	(11) International Publication Number:	WO 00/58782
G02F 1/313		(43) International Publication Date:	5 October 2000 (05.10.00)
(21) International Application Number:	PCT/GB00/01216	(81) Designated States:	AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(22) International Filing Date:	30 March 2000 (30.03.00)	(30) Priority Data:	9907407.2 31 March 1999 (31.03.99) GB
(71) Applicant ( <i>for all designated States except US</i> ): UNIVERSITY OF BRISTOL [GB/GB]; Senate House, Tyndall Avenue, Bristol BS8 1TR (GB).		(72) Inventors; and	
(75) Inventors/Applicants ( <i>for US only</i> ): WHITE, Ian [GB/GB]; 57 Combe Park, Bath BA1 3NH (GB). PENTY, Richard, Vincent [GB/GB]; 55 Redland Road, Bristol BS6 6AG (GB). YU, Siyuan [CN/GB]; 33 Druids Woods, Stoke Bishop, Bristol BS9 1SZ (GB).		(74) Agent:	VIGARS, Christopher, Ian; Haseltine Lake & Co., Imperial House, 15-19 Kingsway, London WC2B 6UD (GB).

## (54) Title: AN OPTICAL CROSSPOINT SWITCH USING VERTICALLY COUPLED WAVEGUIDE STRUCTURE

## (57) Abstract

An optical crosspoint switch structure is disclosed. The switch permits light signals to be diverted from any arbitrary number of input ports to any or several of an arbitrary number of output ports. The switch consists of two groups of intercepting optical waveguides formed on planar substrate, which are the input and output waveguides respectively. At each intersection, another waveguide is formed above the input and output waveguides. Optical coupling between this upper waveguide and the input/output waveguides is controlled by an electrical or optical signal. The upper waveguide has a corner mirror at the intersection. When the control signal allows, light couples from the input waveguide to the upper waveguide. After being reflected by the corner mirror, the light couples from the upper waveguide into the output waveguide. The upper waveguide incorporates the active switching element. Allowing high modulation depth and low crosstalk level.



***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
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DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## INTERNATIO

## SEARCH REPORT

International Application No

PCT/GB 00/01216

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G02F1/313

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SATOSHI BABA ET AL: "A NOVEL INTEGRATED-TWIN-GUIDE (ITG) OPTICAL SWITCH WITH A BUILT-IN TIR REGION" IEEE PHOTONICS TECHNOLOGY LETTERS, US, IEEE INC. NEW YORK, Vol. 4, no. 5, 1 May 1992 (1992-05-01), pages 486-488, XP000272651 ISSN: 1041-1135 the whole document ---	1,4-16

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

19 July 2000

Date of mailing of the international search report

10.08.00

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Diot, P

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01216

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FISH G A ET AL: "SUPPRESSED MODAL INTERFERENCE SWITCHES WITH INTEGRATED CURVED AMPLIFIERS FOR SCALEABLE PHOTONIC CROSSCONNECTS" IEEE PHOTONICS TECHNOLOGY LETTERS, US, IEEE INC. NEW YORK, vol. 10, no. 2, 1 February 1998 (1998-02-01), pages 230-232, XP000733813 ISSN: 1041-1135 cited in the application the whole document ----	16
A	MACIEJKO R ET AL: "ANALYSIS OF AN INGAASP/INP TWIN-OVERLAYERED-WAVEGUIDE SWITCH" IEEE JOURNAL OF QUANTUM ELECTRONICS, US, IEEE INC. NEW YORK, vol. 30, no. 9, 1 September 1994 (1994-09-01), pages 2106-2113, XP000462136 ISSN: 0018-9197 cited in the application the whole document ----	13
P,X	SIYUAN YU ET AL: "Ultra-low crosstalk, compact integrated optical crosspoint space switch arrays employing active InGaAsP-InP vertical waveguide couplers" TECHNICAL DIGEST. SUMMARIES OF PAPERS PRESENTED AT THE CONFERENCE ON LASERS AND ELECTRO-OPTICS. POSTCONFERENCE EDITION. CLEO '99. CONFERENCE ON LASERS AND ELECTRO-OPTICS (IEEE CAT. NO.99CH37013), TECHNICAL DIGEST. SUMMARIES OF PAPERS PRESENTED AT THE, pages CPD24/1-2, XP002142843 1999, Washington, DC, USA, Opt. Soc. America, USA ISBN: 1-55752-595-1 the whole document ----	1,4,6,8, 12,14

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB 00/01216

### B x I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: 2, 3 because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### B x II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

#### Remark on Protest

- The additional search fees were accompanied by the applicant's protest.  
 No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 2,3

Present claims 2 and 3 relate to a method (design approach) and apparatus (switch) defined by reference to a desirable characteristic (minimise crosstalk and increase the modulation depth) using three (different) desirable results i.e. 1) reducing the optical loss or 2) introducing optical gain in the upper waveguide and/or 3) increasing the optical loss of the upper waveguide.

An attempt is made to define the method/apparatus by reference to a result to be achieved (reducing (or increasing ) the optical loss). This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

Independent of the above reasoning, the claims also lack unity. Claims 2 and 3 relate to all method and apparatus having a vertically coupled waveguide whereas claim 1 relate to a vertically coupled waveguide structure having corner mirror at the intersection.

Consequently, the search has been carried out for those parts of the claims which appear to be clear, and so linked as to form a single general inventive concept, namely those parts relating to the methods/apparatus defined by claims 1, 4-16 (as far as depending from claim 1 ).

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

## PATENT COOPERATION TREATY

PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>HL71321/001/CIV</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 00/01216</b>	International filing date (day/month/year) <b>30/03/2000</b>	(Earliest) Priority Date (day/month/year) <b>31/03/1999</b>
Applicant <b>UNIVERSITY OF BRISTOL</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :
  - contained in the international application in written form.
  - filed together with the international application in computer readable form.
  - furnished subsequently to this Authority in written form.
  - furnished subsequently to this Authority in computer readable form.
  - the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
  - the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2.  Certain claims were found unsearchable (See Box I).

3.  Unity of invention is lacking (see Box II).

4. With regard to the title,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/01216

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 G02F1/313

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SATOSHI BABA ET AL: "A NOVEL INTEGRATED-TWIN-GUIDE (ITG) OPTICAL SWITCH WITH A BUILT-IN TIR REGION" IEEE PHOTONICS TECHNOLOGY LETTERS, US, IEEE INC. NEW YORK, vol. 4, no. 5, 1 May 1992 (1992-05-01), pages 486-488, XP000272651 ISSN: 1041-1135 the whole document ----	1,4-16 -/-

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## ° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

19 July 2000

Date of mailing of the international search report

10.08.00

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Diot, P

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/01216

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>FISH G A ET AL: "SUPPRESSED MODAL INTERFERENCE SWITCHES WITH INTEGRATED CURVED AMPLIFIERS FOR SCALEABLE PHOTONIC CROSSCONNECTS"            IEEE PHOTONICS TECHNOLOGY LETTERS, US, IEEE INC. NEW YORK,            vol. 10, no. 2,            1 February 1998 (1998-02-01), pages 230-232, XP000733813            ISSN: 1041-1135            cited in the application            the whole document</p> <p>---</p>	16
A	<p>MACIEJKO R ET AL: "ANALYSIS OF AN INGAASP/INP TWIN-OVERLAYERED-WAVEGUIDE SWITCH"            IEEE JOURNAL OF QUANTUM ELECTRONICS, US, IEEE INC. NEW YORK,            vol. 30, no. 9,            1 September 1994 (1994-09-01), pages 2106-2113, XP000462136            ISSN: 0018-9197            cited in the application            the whole document</p> <p>---</p>	13
P,X	<p>SIYUAN YU ET AL: "Ultra-low crosstalk, compact integrated optical crosspoint space switch arrays employing active InGaAsP-InP vertical waveguide couplers"            TECHNICAL DIGEST. SUMMARIES OF PAPERS PRESENTED AT THE CONFERENCE ON LASERS AND ELECTRO-OPTICS. POSTCONFERENCE EDITION.            CLEO '99. CONFERENCE ON LASERS AND ELECTRO-OPTICS (IEEE CAT. NO.99CH37013), TECHNICAL DIGEST. SUMMARIES OF PAPERS PRESENTED AT THE,            pages CPD24/1-2, XP002142843            1999, Washington, DC, USA, Opt. Soc. America, USA            ISBN: 1-55752-595-1            the whole document</p> <p>-----</p>	1,4,6,8, 12,14

**INTERNATION EARCH REPORT**International application No.  
PCT/GB 00/01216**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: 2,3  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 2,3

Present claims 2 and 3 relate to a method (design approach) and apparatus (switch) defined by reference to a desirable characteristic (minimise crosstalk and increase the modulation depth) using three (different) desirable results i.e. 1) reducing the optical loss or 2) introducing optical gain in the upper waveguide and/or 3) increasing the optical loss of the upper waveguide.

An attempt is made to define the method/apparatus by reference to a result to be achieved (reducing (or increasing ) the optical loss). This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

Independent of the above reasoning, the claims also lack unity. Claims 2 and 3 relate to all method and apparatus having a vertically coupled waveguide whereas claim 1 relate to a vertically coupled waveguide structure having corner mirror at the intersection.

Consequently, the search has been carried out for those parts of the claims which appear to be clear, and so linked as to form a single general inventive concept, namely those parts relating to the methods/apparatus defined by claims 1, 4-16 (as far as depending from claim 1 ).

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

# PATENT COOPERATION TREATY

## From the INTERNATIONAL BUREAU

PCT

**NOTIFICATION OF ELECTION**  
**(PCT Rule 61.2)**

Date of mailing (day/month/year)	ETATS-UNIS D'AMERIQUE in its capacity as elected Office
09 November 2000 (09.11.00)	
International application No.	Applicant's or agent's file reference
PCT/GB00/01216	HL71321/001/CIV
International filing date (day/month/year)	Priority date (day/month/year)
30 March 2000 (30.03.00)	31 March 1999 (31.03.99)
<b>Applicant</b>	
WHITE, Ian et al	

- 1. The designated Office is hereby notified of its election made:**

in the demand filed with the International Preliminary Examining Authority on:

**25 September 2000 (25.09.00)**

in a notice effecting later election filed with the International Bureau on:

- ## 2. The election w

was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p><b>The International Bureau of WIPO</b> 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p>	<p>Authorized officer <b>Zakaria EL KHODARY</b></p>
<p>Facsimile No.: (41-22) 740.14.35</p>	<p>Telephone No.: (41-22) 338.83.38</p>